



North Carolina Department of Information Technology (DIT)

Strategic Energy Management Plan

Measure, Track, and Reduce Energy and Water Consumption at Data Centers (EDC/WDC)

NCDIT-DSC-IOEDC / WDC – 0070

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Prepared for

NC Department of Information Technology

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Executive Summary

The DIT Eastern Data Center facility located at 3700 Wake Forest Rd, in Raleigh, NC, is nearly 40 years old and has housed the State's primary data center for about 29 years. The DIT Western Data Center is 13 years old and has taken on an increasing server load as it has transitioned away from being primarily backup and recovery. It is now a big part of agency consolidation efforts.

Both locations are open 24 hours per day, 365 days per year. At the EDC there typically are about 400 employees working from 8 am till 6 pm Monday through Friday, 30 employees on second shift Monday through Friday, and 20 employees third shift Monday through Friday. Approximately 10 employees are on site for 24 hours per day on the weekends and holidays. At the WDC there are about 34 total employees counting security and janitorial. There are typically about 12-13 employees onsite between 8am and 5pm with the rest covering the other shifts and weekends.

The nature of DIT's Data center facilities differs from most State buildings in that the energy consumption is constantly variable depending on the number of Servers, Network, and other types of Information Technology equipment currently in use. DIT offers numerous IT services supported by the Data centers to the other State Agencies. Much of the IT equipment which is used by these services are in the Data centers. Floor hosted options are also offered to the agencies where they utilize a spot on the Data floor with a DIT supplied rack, power, and cooling. Customers can also supply their own racks/cabinets if desired. The agencies need's change over time and is generally an upward trend from a power consumption view.

Energy Consumption based on square footage does not give an accurate representation of the efficiency of a Data center. The industry standard for Data center efficiency is Power Usage Effectiveness (PUE). That is the ratio between the Total building load and the IT load. The best way to increase PUE is to maximize the amount of IT equipment served and lower the energy consumption of the HVAC and lighting systems. Maximizing the PUE is very much dependent on the other State agencies participation in using more DIT services and/or bringing in more hosted equipment. That said, more equipment being brought in increases our energy

consumption per square foot. We could become vastly more efficient and yet be no closer to reaching the 40% energy reduction per sq foot.

To get to a point where energy per sq foot is somewhat useful both the Eastern and Western Data Centers would need to be full. This would have to happen to even get a viable baseline. Again, since we are serving other State agencies, DIT has limited ability to fully utilize all the power and floor space available. An example would be an agency that pays for seven racks and only uses four of them with the others held for future growth. On a floor space basis, the Data center utilization is about 50%.

Energy and Water Data Management: WDC Facilities began using spreadsheets to monitor water and diesel fuel in 2009 and Electricity in 2015. Annual data for cost and usage for electricity, fuels and water have been reported to the NC Energy Office since 2007-08 when the WDC was first built. The EDC has been reporting to the energy office since it was required. There will be a renewed focus on monitoring energy consumption going forward. From the meter all the way down to equipment level at both data centers. This will allow us to find the areas we need to concentrate on. We hope to get a combined PUE chart for both data centers in the coming year.

Energy and Water Supply Management: Electric, Water and Fuel bills are reviewed monthly and abnormal usage is investigated. The Facility Manager's meet with Duke Energy representative's at least once a year to review rates and anything that may affect each Data Center.

Equipment and Building Efficiency: Regular documented equipment maintenance enables the equipment to run as efficiently as possible. Walls and windows are resealed as needed.

Existing Conditions: The EDC is a 94,343 with about 15,000 sq ft. of data floor with the rest being office space, warehouse, and shipping. Two Carrier Air Handlers. We have three Trane Chillers (each at 500 tons), 1 Rheem Round 120 Gallon Tank and Rheem Round 50 Gallon Tank for the building HOT water.

Novar Controls-for all HVAC points. Three 2500kw Caterpillar generators.

The WDC is a 53,000 sq ft. Data Center with two 500-ton and one 50-ton Trane Chillers, three 2500kw Caterpillar generators, and three 750kw Emerson UPS. The building is designed to support the IT operations of the 15,000 sq ft. data floor, office space, small warehouse and receiving.

The Department of Information Technology will strive to meet the goals set forth in EO 80. We will work toward conservation of energy and water resources at all our locations by creating, implementing, and following an effective Energy and Water Management Plan. The objective of the Plan is to guide the fiscally and environmentally responsible usage of valuable resources in accordance with state legislation, while striving to ensure a safe environment that provides an acceptable level of comfort for staff, and visitors.

FY 2019/20 Usage

Factors

Several unusual factors came into play in 2020. The Covid-19 Pandemic has greatly reduced onsite work at the EDC with hundred employees working from home. IT personnel at the WDC are also working predominantly from home, however at the WDC this is offset by multiple vendor personnel being onsite with the fiber project.

The WDC Fiber project required 3-4 weeks of intense under the floor work in the Data room. During this time, large number of tiles were removed to perform the work. Our fan gallery fans were running at full capacity 8-9 hours a day during this time. A 40-50% increase over normal.

The WDC Building Management System was upgraded over three phases starting in February. During this time, the main controller and software, AHU 1-2 controllers and the Chiller Plant controllers were replaced. Over the course of the upgrade, both 500-ton chillers were run at the same time multiple times for several hours for testing. Other Air handlers and equipment were run more than usual as well. Spring is the time of year we would typically see a reduction in power consumption.

Due to these factors the WDC saw a very slight increase in electrical consumption this year. The EDC saw a decrease in electrical consumption at least partially due to the pandemic. Both data centers saw a large decrease in Diesel fuel consumption. Primarily due to better weather conditions over the previous year and reduced run times at the WDC. We also went to a once a

month schedule for several months due to the pandemic. Winter weather and Hurricanes can greatly increase the amount of run time needed.

BTU's per square foot were down significantly this year. 318,196 vs 360,839.

Metric	Baseline 2002-03	Current 2019-20	% Change
Gross Square feet	94,343	163866	74%
Utility cost	\$362,255	\$1,204,029	232%
Btu per square foot per year	272,914	318,196	17%
Cost per million Btu	\$13.67	\$20.62	51%
Water gallons per square foot	90	72.51	-19%
Water cost per thousand gal	\$1.23	\$10.64	765%

2019/20 updates

- We are now running three mechanical cooling units in the UPS room at the WDC rather than four. Cooling is still maintained within recommended temperature and humidity for the UPS.
- The Bi-weekly generator test runtime was reduced by 20 minutes at the WDC and has contributed to lower fuel consumption this year.
- Water heater for eyewash station shut off. Not needed to maintain water within OSHA specifications.
- 1000 LED plug and play Philips bulbs were purchased for installation in the Data room during the 20-21 year. Installation is underway.
- All the lighting at the EDC was replaced with LED and completed during the 19-20 year.
- Computer room air conditioners were replaced at the EDC during the 19-20 year with new more efficient units.

- Lag Chiller setting at the WDC was reduced from 1 hour to 30 minutes. Lag chiller typically runs 3-4 times per year during testing and sometimes due to power outages. The reduction is the amount of time it will run after temps are normal.
- During the WDC BMS upgrades it was found that we can run the AHU chilled water loop at a higher pressure and lower gallons per minute with greater cooling efficiency.

Goals for 2020-21

Focus Areas

78% of the WDC's building load is the Chillers and UPS server and network load. The remaining 22% is Pumps, Air Handling, heating, and lighting load. 50% of the load is the servers and networks. Managing the servers and networks with efficiency in mind must be a priority. When new equipment is purchased, high efficiency must be part of the purchase criteria. Agency hosting customers must be part of the process as well.

We need a renewed focus and buy in from upper management and HR to reduce energy usage by adopting a personal appliance use policy. Space heaters in particular are inefficient and can be a fire hazard. Reduction in energy usage by implementing computer power management for all ITS personal computers (where applicable). Purchasing energy efficient computer equipment, Servers, storage units, tape drives, where applicable. We need continued analysis of both Data Centers to potentially lower energy usage by increased efficiencies.

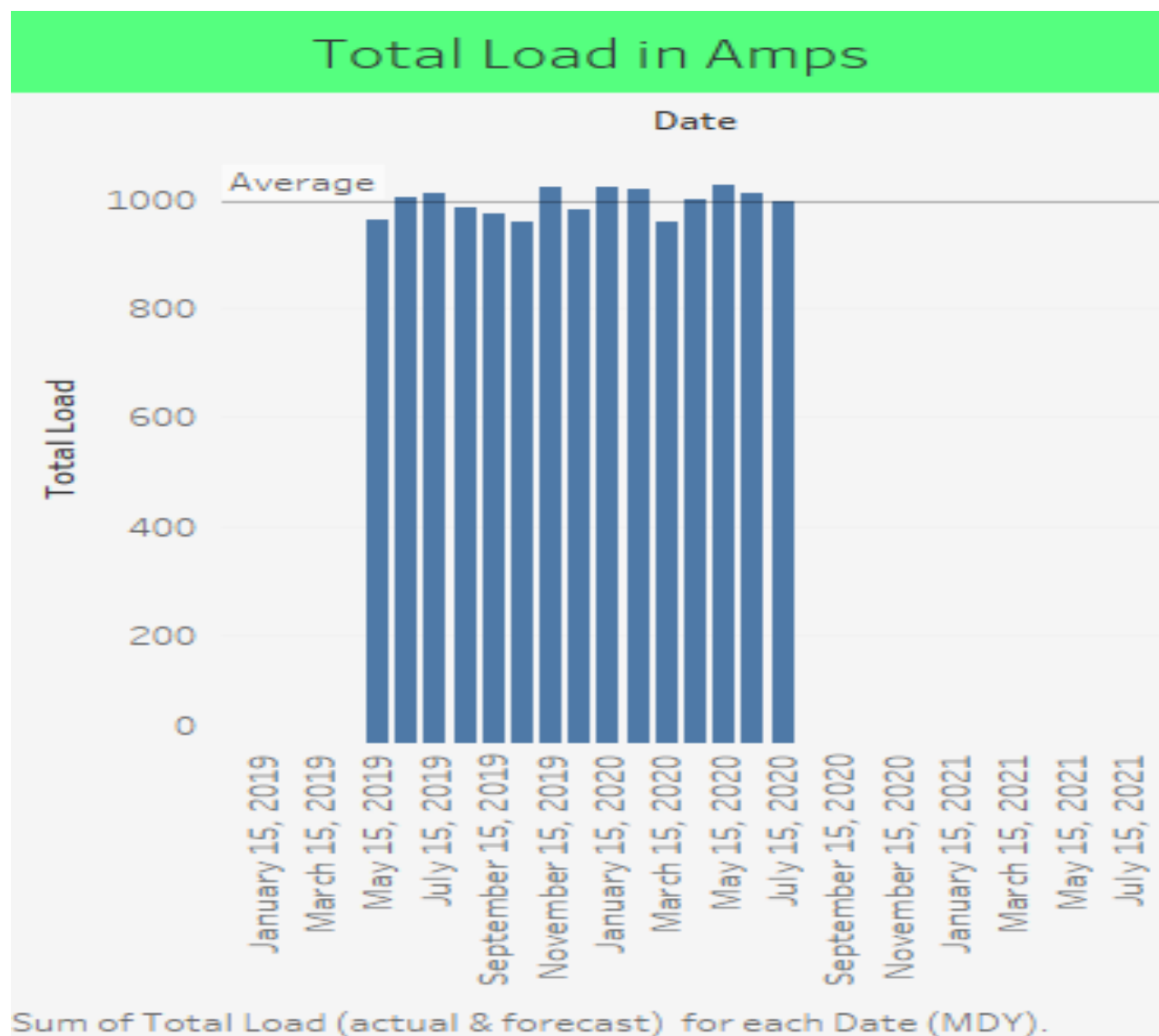
- Continue with energy efficiency training opportunities.
- EDC to have the electrical distribution project engineering study done this year. Though it is not specifically an energy reduction project, when the project is completed, we expect greater electrical monitoring capabilities, higher efficiency equipment and reliability.
- Complete the Data room LED installation at the WDC.
- Continue installing LED's in the rest of the WDC as the fluorescents fail.

- Start monitoring the PUE of the EDC like is being done at the WDC. With the current setup at the EDC it will be cumbersome to start, but after the electrical upgrades are done it should be much easier.
- Create a combined Data center PUE chart.
- Sixteen new server cabinets installed in June 2020, were equipped with smart power bars that will allow control and monitoring down to the outlet level. Upgrades in the future for all the existing cabinets is in the planning stages. (funding dependent)
- Continue monitoring both water and electrical metering to ensure it is correct and meet with Duke energy representative twice per year to stay abreast of anything that may affect our rates or service.
- Investigate water consumption at the EDC. It is still substantially higher than the EDC even with most of the IT staff working from home.

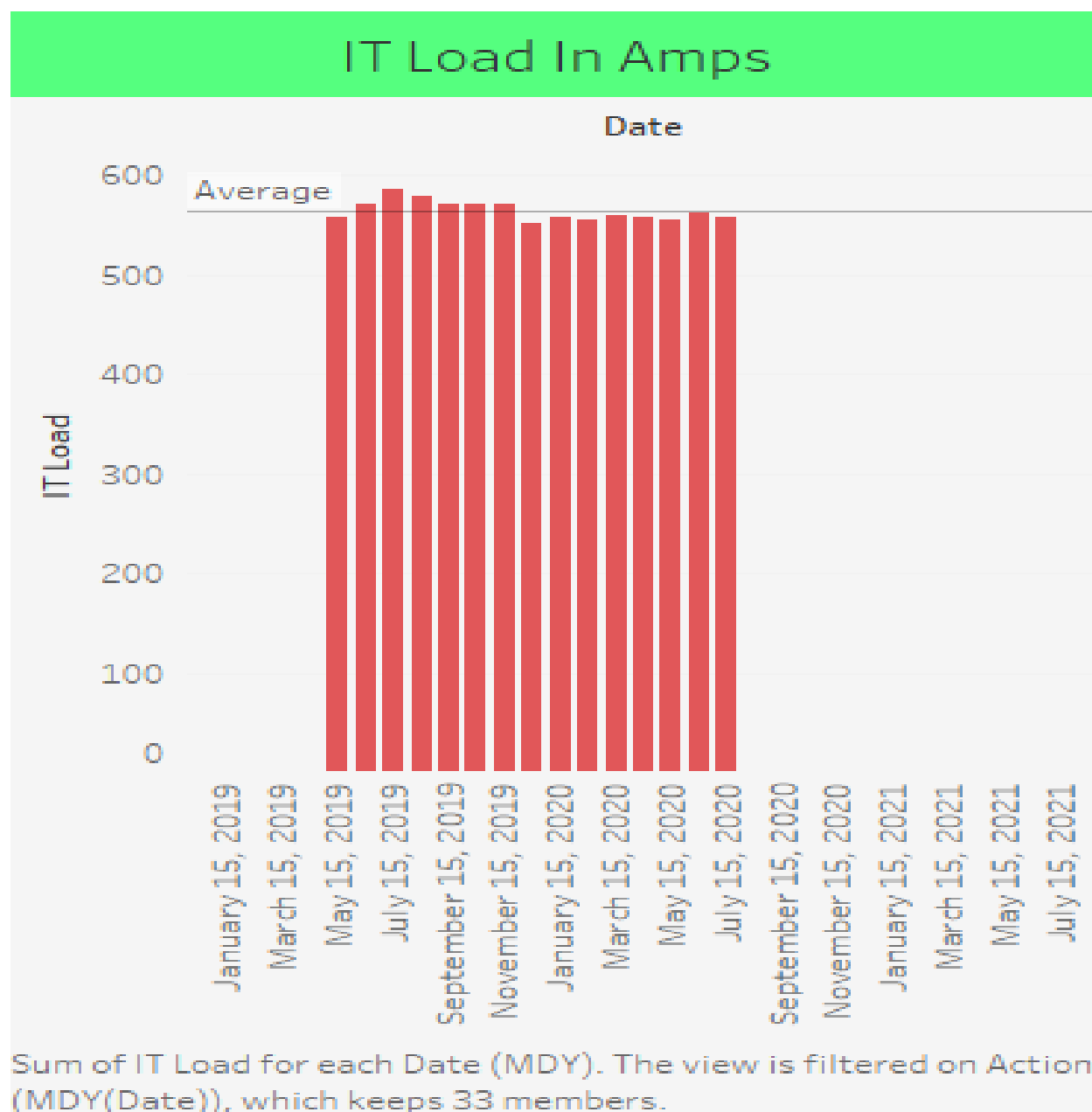
Future projects

- Work on potential funding for a more efficient third chiller at the WDC.
- Scheduled replacement of the existing UPS units at the WDC with more efficient units. 85% vs 93-97%. Two to three years out.
- EDC to complete the electrical distribution project. Funded.
- Enclosed cold aisles at the WDC. Not funded. Need to work up potential savings.

Graphical Representation of the WDC Electrical loads

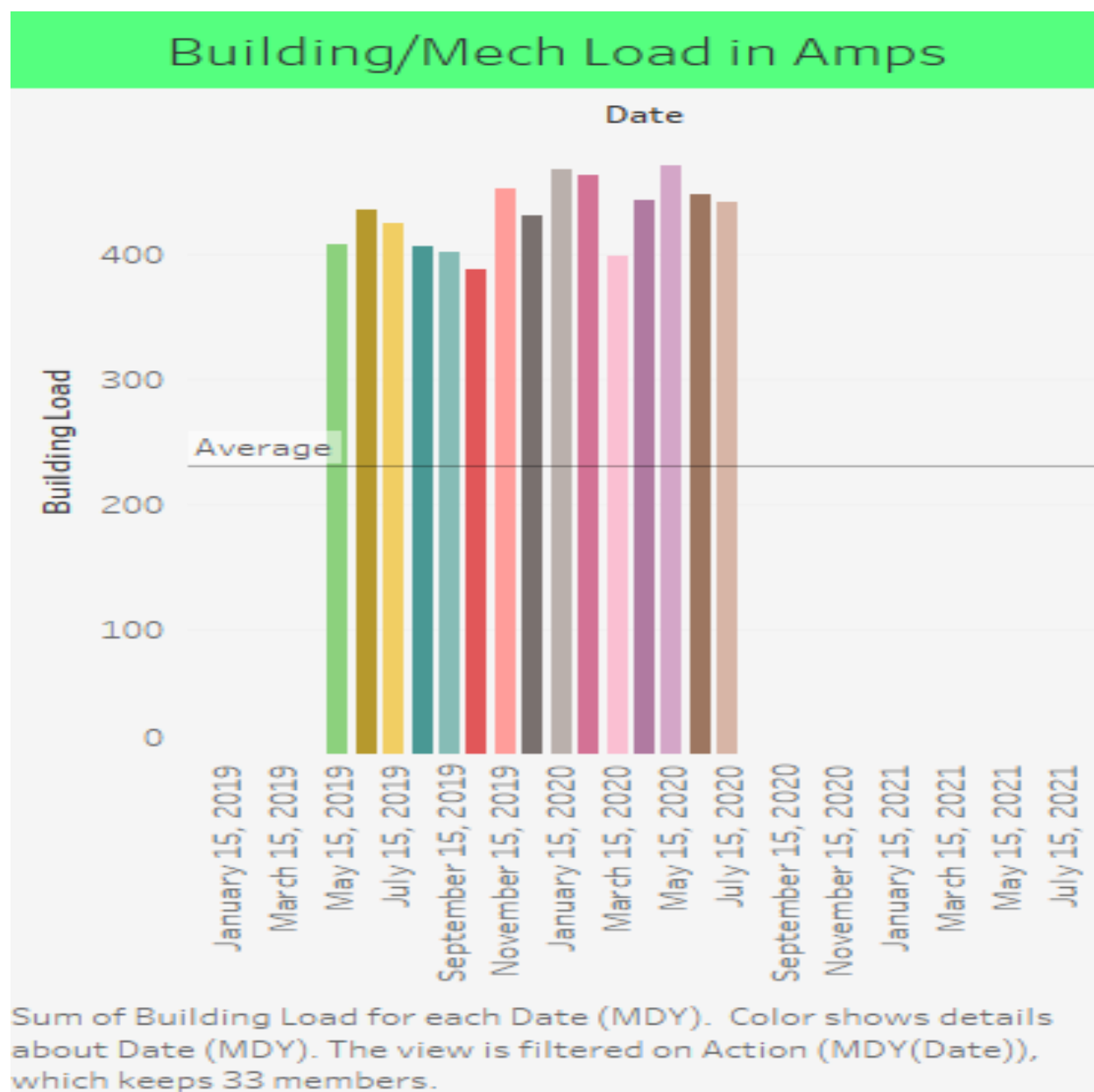


This May and June year over year were likely higher due to the fiber and building management system projects and upgrades.

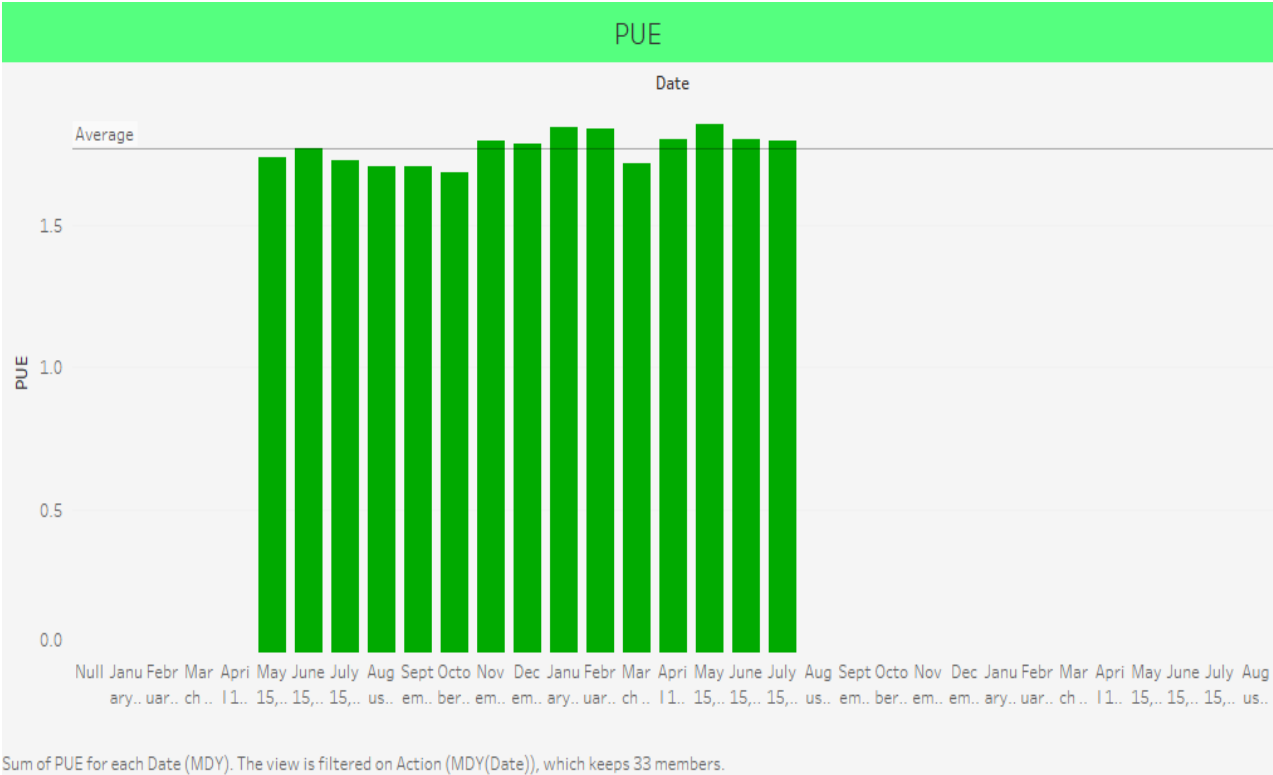


IT load has trended downward due to changes in the amount of equipment in the Data room.

Refreshes and virtualization account for the trend.



Mechanical Cooling loads trended up during the spring and summer due to the Fiber and BMS projects.



Power usage effectiveness (PUE) is the industry standard for Data Center efficiency monitoring. It is the Total building energy/Total IT loads. The idea is that the IT load should be the predominant consumer with the rest of the building loads as low as possible. IT loads that come into DIT's data centers can be handled more efficiently and helps the other state agencies lower their energy consumption.

The WDC PUE has been as low as 1.68 to a high of 1.85 this past year and has trended upward in recent months due to the lower IT load and the spring/summer projects.

Progress

Consumption has dropped to 17% over 02/03 btu/sf levels. This is the best we have been since 05/06. Note: In the early 2000's DIT was a much smaller agency that did not house the number of servers and IT equipment that we do today. That fact greatly contributes to the difficulty in achieving EO80 requirements, however that in no way prevents us from working to reduce consumption as much as we can while maintaining Data center reliability.

	energy evaluation						water/sewer evaluation				
	energy \$ avoided	energy \$/gsf	\$/mmbtu	\$/mmbtu %change	btu/sf	btu/sf %change	water \$ avoided	\$/kgal	\$/kgal %change	gal/sf	gal/sf %change
02/03		\$3.73	\$13.67		272,914			\$1.90		58.03	
03/04	-\$13,911	\$4.17	\$14.72	8%	282,930	4%	-\$1,504	\$1.69	-11%	67.46	16%
04/05	-\$36,880	\$4.30	\$14.31	5%	300,237	10%	-\$1,551	\$1.71	-10%	67.63	17%
05/06	-\$83,065	\$5.09	\$15.44	13%	329,943	21%	\$85,297	\$15.63	722%	0.17	-100%
06/07	-	\$6.09	\$16.60	21%	366,747	34%	\$53,728	\$9.88	420%	0.37	-99%
07/08	\$123,483	\$5.58	\$17.37	27%	321,172	18%	\$94,500	\$12.58	562%	7.03	-88%
08/09	\$285,594	\$6.74	\$17.92	31%	375,794	38%	-\$11,655	\$5.46	187%	71.82	24%
09/10	\$336,266	\$7.03	\$18.24	33%	385,416	41%	\$8,572	\$7.43	291%	50.99	-12%
10/11	\$439,696	\$7.72	\$18.45	35%	418,371	53%	-\$4,351	\$7.54	297%	61.56	6%
11/12	\$368,901	\$7.48	\$19.15	40%	390,467	43%	-\$4,246	\$8.18	331%	61.20	5%
12/13	\$336,030	\$7.40	\$19.59	43%	377,583	38%	-\$1,587	\$8.21	332%	59.21	2%
13/14	\$298,519	\$7.41	\$20.48	50%	361,852	33%	-\$9,858	\$9.39	394%	64.44	11%
14/15	\$283,613	\$6.93	\$19.04	39%	363,819	33%	-\$13,509	\$9.44	397%	66.77	15%
15/16	\$338,243	\$7.91	\$21.42	57%	369,266	35%	-\$29,807	\$10.18	436%	75.90	31%
16/17	\$252,457	\$7.16	\$20.59	51%	347,729	27%	-\$24,755	\$10.42	448%	72.53	25%
17/18	\$254,542	\$6.87	\$19.49	43%	352,622	29%	-\$20,913	\$10.64	460%	70.03	21%
18/19	\$294,877	\$7.39	\$20.47	50%	360,839	32%	-\$37,215	\$11.39	499%	77.97	34%
19/20	\$153,011	\$6.56	\$20.62	51%	318,196	17%	-\$25,726	\$10.84	471%	72.51	25%

NC DIT Western Data Center Energy and Water Management Plan Mandate

The Department Heads will review progress and results annually and will support staff attendance at training in energy and water management.

Our tracking measures will be the following Key Performance Indicators (KPI):

Total Energy Use Btu per Square Foot per year

Water gallons per Square Foot per year

Power usage effectiveness

Commitment

We recognize that energy and water consumption can be managed to our benefit. Energy and water management is a responsibility of the occupants at each facility. The attached plan outlines the activities and expenditures required to reduce energy and water consumption to achieve the goals of the program.

Strategic Energy Management Plan Mandate- Commitment

I have read and support the Strategic Energy Plan for my Organization Implemented this __ day of ____

Facilities Manager

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Jony Brackett

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8/26/2020 | 1:26 PM

Date

Operations Director

DocuSigned by:

Henry Taylor

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8/26/2020 | 2:06 PM

Date

Chief DSCIO

DocuSigned by:

Susan Kellogg

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8/28/2020 | 8:07 AM

Date

